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AUTHOR Gentner, Dedre; Stuart, Patricia
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ABSTRACT

A study investigated developmental changes in children's fluency in interpreting metaphors. Specifically, it examined the development of an implicit interpretation strategy found in adults of mapping relational structure from base to target. Ten subjects from each of three age groups--five to six years, nine to ten years, and college-age students--interpreted attribute, relation, and double metaphors. In attribute metaphors, the predicates shared by the base and target objects were object-attributes (both are round). In relation metaphors, the shared predicates were relations (both help people get well), while in double metaphors, both attributes and relations were shared. The major result of the study was that the relationality of the responses increased significantly with age, while attributionality showed no age increase. The findings indicate a developmental increase in relational focusing; other aspects of the data suggest that this trend may be due in part to the accretion of knowledge. (A list of materials used in the study and sample interpretations are appended.) (FL)

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Technical Report No. 315

METAPHOR AS STRUCTURE-MAPPING: WHAT DEVELOPS

Dedre Gentner
Bolt Beranek and Newman Inc.

Patricia Stuart
Toshiba America Inc.

June 1984

University of Illinois
at Urbana-Champaign
51 Gerty Drive
Champaign, Illinois 61820

BBN Report No. 5479
Bolt Beranek and Newman, Inc.
10 Moulton Street
Cambridge, Massachusetts 02238

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Abstract

This research investigated the development of metaphor. Specifically, we studied the development of an implicit interpretation strategy found in adults of mapping relational structure from base to target. Children aged 5-6 and 9-10 and adults interpreted metaphors of three types: Attribute, Relation, and Double. In Attribute metaphors the predicates shared by the base and target objects were object-attributes: e.g., "Both are round." In Relation metaphors the shared predicates were relations: e.g., "Both help people get well." In Double metaphors, both attributes and relations were shared.

The attributionality and relationality of the interpretations were scored by independent judges. The major result is that the relationality of the responses increases significantly with age. Attributionality shows no age increase. These results indicate a developmental increase in relational focusing. Other aspects of the data indicate that this trend may be due in part to the accretion of knowledge.

Metaphor as Structure-Mapping: What Develops

Experimental studies show a marked developmental change in children's fluency at interpreting metaphors. A four-year-old asked, "Can a person be sweet?" answers literally: e.g., "Not unless he was made out of chocolate" (Asch & Nerlove, 1960). Similarly, young children are poor at matching sentences with metaphorically related pictures (Kogan, 1975); and at choosing appropriate metaphorical completions for sentences (Gardner, Kircher, Winner, & Perkins, 1975). These and many other experimental results seemed to indicate that metaphorical ability develops gradually and late. Until a decade ago, this was the dominant position (e.g., Inhelder & Piaget, 1958).

However, observations of spontaneous speech lead to a different conclusion (Chukovsky, 1968; Winner, 1979). For example, a fifteen-month old girl used "moon" to refer not only to the moon but to a half-grapefruit and a hangnail (Bowerman, 1976). Tad, a two-year-old boy, observed that a crescent moon was "bent, like a banana." On another occasion he jumped into a pile of pillows and announced "leafs." It is unlikely that all such extensions can be accounted for as errors in meaning or usage (see Bloom, 1973; Thomson & Chapman, 1975; Winner, 1979). Such discrepancies suggest that a reanalysis of the phenomenon is required.

We must separate the course of genuine metaphoric development from various other contributors to task performance. To do this, we need a theory of metaphoric competence. In this paper we use the structure-mapping theory of analogy (Gentner, 1980, 1982, 1983; Gentner & Gentner, 1983) as a framework for developmental questions. This theory describes a set of rules by which the interpretation of an analogy is derived from the meanings of its terms. The central principle is that, for adults, metaphors and analogies are mappings from one semantic domain (the base domain) to another (the target domain), which convey that certain semantic relationships in the base domain exist in the target. Elements in the base are placed in correspondence with elements in the target. Predicates are mapped from base to target according to the following mapping rules: (a) Relations between objects (such as ATTACK[x,y]) tend to be mapped across; (b) Attributes of objects (such as RED[x]) tend to be dropped; (c) The particular relations mapped are determined by systematicity, as defined by the existence of higher-order constraining relations which can themselves be mapped.

As an example, consider A. E. Housman's metaphor, "I can no more define poetry than a terrier can define a rat." Clearly Housman does not mean to convey that poetry is like a rat. We are not meant to map the object-attributes of rats onto poetry, nor those of terriers onto the poet. Instead, the intended interpretation maps a system of relations: e.g., PURSUE

(terrier, rat), ALTHOUGH/UNABLE [DEFINE (terrier, rat)] / carries across into PURSUE (poet, poetry), ALTHOUGH/UNABLE [DEFINE poet, poetry)]/. For adults, the system of shared relations constitutes the ground--the set of implicit commonalities between base and target--and plays an important role in memory for metaphors and analogies (Verbrugge, 1975; Verbrugge & McCarrell, 1973).

Once metaphoric processing is viewed as a mapping, it becomes clear that factors other than metaphorical ability have contributed to the developmental trends in some of the experimental tasks (Gentner, 1977a,b). One common confounding is use of conventional metaphors (e.g., "hard-hearted" or "trigger-tempered") for which standard interpretations can be learned. Another is differences in domain knowledge. Children's ability to demonstrate metaphorical ability is limited by their knowledge of the domains involved. For example, without knowledge of our cultural models of personality and emotion, children could not produce appropriate interpretations of such metaphors as a "hard/soft person" or "sweet/bitter feelings," regardless of their metaphorical ability. A third factor limiting children's performance is their understanding of the task pragmatics. Young children given a question like, "Can a person be sweet?" may be more likely than older children to assume that their literal knowledge of word meaning is being called into question; and to

respond literally even if they are capable of metaphorical responding.

If these confounds are removed, can young children demonstrate metaphoric ability? Two earlier studies demonstrate that preschool children possess basic metaphoric competence: i.e., that they can map systems of relations consistently from base domain to target domain under the right circumstances (Gentner, 1977a,b). Subjects were asked to map from the base domain, a human body, to the target domain, a pictured concrete object. For example, a child was shown a picture of a tree and asked, "If the tree had a knee (or shoulder, etc.), where would it be?" Children as young as four-to-five were able to perform the mapping as well as adults. Even under difficult conditions--when the pictures were turned upside down, or when misleading local details were added to the pictures--children preserved the set of transitive vertical relations that hold among body parts.

These tasks satisfy four criteria for a fair assessment. First, no conventional metaphors were used. Second, even the youngest children were familiar with the conceptual domains. Moreover, since the target domains were presented pictorially, the children had no difficulty accessing the required spatial relations. Relations in the base domain, the human body, were also available for inspection; and indeed, some of the younger children occasionally glanced at their own bodies in deciding on their answers. Third, the phrasing of the question as "If a tree

had a knee, where would it be?" makes it clear that the child is to use an analogical interpretation. To underscore this last point, compare children's responses to two trial queries: when asked "Can a chair have an elbow?" and "Can a hill have hair?," every single preschooler answered "No" to both. Finally, it is important that there was an objective, theoretically based criterion for level of performance.

In recent times there have been a fair number of other studies designed to allow young children to demonstrate as much of their competence as possible. These studies have avoided many of the old confoundings; they provide naturalistic contexts for metaphor interpretation and utilize responses such as pointing or acting out, rather than verbal explanation (e.g., Dent & Ledbetter, 1983; Vosniadou & Ortony, 1983; Winner, 1983). Each of these "fair test" studies has succeeded in demonstrating some early metaphoric ability. Yet there remain strong age differences.

The results of the last decade of research leave no doubt that preschool children possess basic metaphoric ability. It is equally clear that there is still a developmental progression to be accounted for. We are now ready for a more precise set of questions. Given that the bulk of the findings show a developmental progression, is this due to the learning of better mapping strategies for analogy, or to the accretion of domain-specific knowledge, or to some deeper cognitive change (see

Carey, in press; Conner, 1983). In order to examine more closely the reasons that young children perform well or badly in metaphoric tasks, we asked children to interpret metaphors of different types across several different domains. We then analyzed the propositional structure of their responses.

In prior experiments, adults have been found to obey the structure-mapping rules described above. When asked to interpret metaphorical comparisons, adults focus on relational information, rather than object-attribute information; and they consider those metaphors more apt for which relational mappings can be found (Gentner, 1980). Therefore, in the present study we address the following developmental questions: (a) do young children show this relational focus; and (b) if they fail to demonstrate relational mappings in some situations, exactly why are they failing.

We collected interpretations of metaphors from children and adults, as well as aptness ratings of the metaphors. These interpretations were then scored by independent judges for relationality and attributionality. There were three metaphor types: attributional metaphors [e.g., "Pancakes are nickels." (Both are round)]; relational metaphors [e.g., "A tire is a shoe." (Both are used by moving figures as points of contact with the ground.)]; and double metaphors with both attributes and relations in common [e.g., "Plant stems are like drinking straws." (Both are long and cylindrical; both are used to bring

liquids from below to nourish a living thing.)]. According to the theory, an ideal responder should show three characteristics. First, for relational and double metaphors, the metaphor interpretations should include many relational propositions and not many object-attributes. (For the attribute metaphors, there is no choice but to focus on attributes, since no relations are shared by the base and target.) Second, the aptness ratings should be positively correlated with the relationality of the metaphor interpretations. Finally, as a corollary to the first two predictions, the aptness ratings should be lower for attribute metaphors than for relational and double metaphors.

The method was designed to minimize the influence of other developmental changes besides metaphorical development. First, to circumvent differences in pragmatic knowledge, a series of amplifications was designed to make the point of the question clear to the children. Second, in order to minimize differences in domain knowledge, we used highly familiar domains. Finally, to rule out prior exposure as a developmental confounding, the comparisons were novel; no idioms or conventional metaphors were used.

Method

Subjects. There were ten subjects from each of three age groups: five- to six-year olds (5 boys and 5 girls), nine- to ten-year olds (4 boys and 6 girls) and college students from psychology classes at the University of California at San Diego

(7 males and 3 females). The children were recruited from schools in Del Mar and La Jolla, California and were of approximately the same middle-class SES as the college subjects.

Stimuli. There were eight instances of each of three types of metaphor: (a) attribute metaphors, in which base and target shared many attributes but few relations; (b) relation metaphors, in which base and target shared many relations but few attributes; and (c) double metaphors in which base and target shared both relations and attributes. Examples of the three kinds of metaphors are:

Attribute: The sun is like an orange. (Both are round and orange.)

Relation: A camera is like a tape recorder. (Both record events to re-experience at a later time.)

Double: A hummingbird is like a helicopter. (Both have stubby shapes and blurry parts; both use rapid motion to achieve maneuverability in air.)

There were twenty-four comparisons in all, as shown in Table 1. All subjects interpreted all the metaphors.

Insert Table 1 about here.

Procedure. The task was administered to the adults in written form, in groups. To be sure that the children understood all the terms, all subjects were first asked to describe the

separate objects that later appeared in the metaphors. Indeed, all subjects succeeded in producing enough correct descriptive information to demonstrate basic familiarity with each object. The objects were presented in random order, unpaired. They were not told about the metaphor task at this time.

After completing the object descriptions, subjects were shown the metaphors. Adults were asked to write out their interpretations of the metaphors. They were also asked to rate the aptness of the metaphors--i.e., how clever, interesting or worthwhile they were--on 1-5 scales. In addition, adults rated the metaphoricity of each comparison--i.e., the degree to which the comparison was one of literal similarity versus a metaphorical (nonliteral) comparison. Metaphoricity ratings were not elicited from children and are not considered further here.

The task was administered to children orally and individually. The children's responses were tape recorded. They were first asked to describe the 48 objects involved. Then they were asked to interpret the metaphors. A graded series of questions was used to be sure that the children understood the task.[1] The experimenter would ask, "Is a hummingbird a helicopter?". If the child responded literally ("No, a hummingbird is a bird."), the experimenter asked, "What does it mean if I say 'A hummingbird is a helicopter.'?". If the child still responded literally, the experimenter asked, "What does it mean if I say 'A hummingbird is <u>like</u> a helicopter.'?". If the

child gave any comparison interpretation after any of the questions, the experimenter went onto the next comparison. Most children after a few such sequences caught on that a nonliteral response was in order and thereafter produced one after each new query. After interpreting the metaphor, children rated its aptness by pointing to one of five schematic faces, ranging from very sad (low aptness) to very happy (high aptness).

Scoring. Groups of from two to four trained judges rated the responses on two five-point scales, a relational scale and an attributional scale. These judges had first received six hours of training in the use of propositional notation. They rated each metaphor interpretation as to its relationality--i.e., whether its predicates expressed relations between objects in the domain--and its attributionality--whether its predicates described objects in and of themselves. An interpretation received a 5 rating on relationality (attributionality) if it included any clearly relational (attributional) statement. This method was sensitive to the presence or absence of relational (or attributional) information in a given interpretation, and relatively insensitive to the number of different relations (or attributes) mentioned in an interpretation. We chose this scoring method to minimize the effect of differences in length of responses.

The basic scoring decision was whether a proposition expressed a one-place predicate (an attribute) or a 2-or-more

place predicate (a relation) over the domain. Most adjectives are attributes; e.g., "Both are yellow" is an attribute. It can be written as a one-place predicate, YELLOW(X). A transitive verb, such as "Both help people" is a relation. It can be written as a two-place predicate, HELP(X, people). Other relational terms include comparative adjectives (e.g., "longer than") and prepositions (e.g., "behind"). A decision had to be made about certain relations which can also be expressed as surface attributes (see Miller, 1979). For example, the proposition "X puts people to sleep" is clearly a relation. However, the adjectival proposition "X is soporific" is a one-place predicate on the surface (soporific[x]), but actually conveys the relational information that there exist being(s) whom X puts to sleep. Such relational adjectives were scored as 3 on the relational scale and 3 on the attributional scale.

The metaphor interpretations were read in random order, so that none of the judges knew the ages of the subjects. They were not told the aptness rating or metaphoricity rating of the original metaphors. Only one of the judges knew the design of the experiment. Inter-rater agreement ranged from 85% to 100% on different metaphors. Table 2 shows sample responses scored as relational or attributional.

Insert Table 2 about here.

Results

The major result is a strong upward developmental trend in the use of relations in the interpretations. Figure 1a shows the rated relationality of the interpretations for the three types of metaphor across age. Relationality increases steadily with age for the metaphors that permit relational interpretation--i.e., the relational and double metaphors. Attribute metaphors, of course, show no such increase, since they were designed to have only attributes in common between the base and target.

In contrast, there is no developmental increase in propensity to use attributional information. As Figure 1b shows, within each class of metaphor, the attributionality ratings were constant across age.

Insert Figure 1 about here.

Two separate two-way, 3 (Age) X 3 (Metaphor Type) analyses of variance were performed: one for the relationality ratings and one for the attributionality ratings. In the relationality analysis, both the main effect of Age and the Age X Metaphor-type interaction were significant, $F(2,27) = 12.76$, $p < .01$; $F(4,54) = 5.48$, $p < .01$. This Age effect confirms a strong developmental trend in the use of relations in metaphorical interpretation. The Age X Metaphor-type interaction reflects the fact that, as

expected, the age increase in relationality occurs only for the relational and double metaphors.

On the attributionality analysis, there was no significant main effect of Age; nor was the Age X Metaphor-type interaction significant. There is no developmental trend in propensity to produce attributional interpretations of metaphors.

In both the relational and attributional analyses, the main effect of Metaphor type was strongly significant; $F(2,54) = 191.63$, $p < .001$; $F(2,54) = 265.06$, $p < .001$, respectively. For all ages, the relational comparisons received the highest relational ratings and the attributional comparisons received the highest attributional ratings. The double comparisons are intermediate on both rating scales. Thus, the results agree well with *a priori* categorization of stimuli. This orderly pattern is a good sign.

The performance on double metaphors is of special interest. By design, the double metaphors could support either an attributional or a relational interpretation. To see which kind of propositions subjects focused on in double metaphors, planned comparisons were performed between the relationality ratings and the attributionality ratings of the double metaphors, within each age group. For the two older age-groups, the mean relationality for the double metaphors is significantly greater than the mean attributionality. [For age 9-10, $t(9) = 2.78$, $p < .05$; and for adults, $t(9) = 3.79$, $p < .05$.] However, for the 5-6 year-olds,

there is no significant difference between relationality and attributionality for double metaphors [$t(9) = 1.93$, NS]. This pattern again suggests a developmental shift towards relationality.

Aptness ratings. As predicted by the structure-mapping theory, the aptness ratings for adult subjects were positively correlated with relationality, $r(20) = .55$, $p < .01$; but not with attributionality. Indeed, the adult aptness ratings were negatively correlated with attributionality, $r(20) = -.42$, $p < .05$. These patterns replicate the positive correlation of aptness with relationality, but not with attributionality, found in prior research with adults (Gentner, 1980).

Children do not show these patterns. There were no significant correlations between aptness and either relationality or attributionality for either of the age groups of children.

Another indication that relationality figures heavily in adult aptness judgments is that adults' mean aptness ratings for double and relational metaphors are considerably higher than for attribute metaphors, $t(7) = 2.8$, $p < .05$. As Figure 2 shows, children do not show this pattern: their mean aptness ratings do not differ significantly across the three types of metaphors. We must be cautious here, since the children may simply have lacked facility with the aptness scale. Still, these data suggest a developmental difference in implicit criteria for juding aptness in metaphor.

Insert Figure 2 about here.

Propositional count. In order to consider whether greater knowledge affected the adults' responses, we made a further count of number of different propositions used by each subject on each metaphor. For all three classes of metaphors, adults mention significantly more proposition types than either group of children, as shown in Figure 3. The two groups of children differ only on attribute metaphors, for which the older children produce more proposition types than the younger group. This finding of an age increase in the number of types of propositions mentioned suggests that the developmental difference in metaphor interpretation stems partly from increases in domain knowledge.

Insert Figure 3 about here.

Discussion

As predicted by the structure-mapping theory, the adults in this study focused on mapping across relational systems. There are several indications of this pattern. First, adult responses were rated high in relationality overall. Second, in particular when given metaphors that could support either a relational or an attributional interpretation (the double metaphors), adults interpreted them more relationally than attributionally. Third,

adults rated the relational and double metaphors as more apt than the attribute metaphors. Fourth, aptness for adults correlates positively with judged relationality, but negatively with judged attributionality. Adults appear both to seek relational predicates in metaphorical mapping and to judge the aptness of the comparison according to the relationality of the mapping.

The children did not show this strong relational focus. The tendency to produce relational interpretations increased markedly with age over the period from five years to adulthood. The treatment of double metaphors also showed a developmental trend. For nine-year-olds, double metaphors were interpreted more relationally than attributionally, just as for adults. But for five-year-olds, there was no significant difference between the relationality and attributionality of the double metaphors, and indeed the mean attributionality was slightly higher. Finally, for both groups of children, the aptness ratings showed no preference for relationally interpreted metaphors.

Overall, these results show a clear developmental increase in relational focus. Now we must ask what underlies this developmental change. The structure-mapping framework suggests four possible reasons that children might fail to map relational structure: (a) they might lack the basic competence to abstract shared relations; (b) they might be able to perform simple relational mappings, but lack the ability to map complex sets of relations; (c) they might lack the implicit rule that metaphor

and analogy involve mappings of relational systems, and therefore include other kinds of likenesses; (d) they might possess both the correct understanding of metaphoric mapping and the ability to map complex relational systems, but still fail due to lack of knowledge of the relevant domain relations. Reasons (a) or (b) would mean that it is the basic cognitive capacity for metaphoric processing that develops--i.e., some aspect of the ability to carry out the relational mapping. In contrast, reasons (c) and (d), in different ways, implicate the acquisition of knowledge rather than the growth of cognitive ability (see Brown & Campione, in press, and Carey, in press, for discussions of this issue). Reason (c) would mean that what changes is pragmatic knowledge of the implicit rules for analogy and metaphor, and of the difference between analogy/metaphor and literal similarity. Reason (d) would mean that what changes is the amount and depth of domain knowledge.

The research presented here does not settle the question completely, but, in combination with other work, it will allow us to narrow the set of hypotheses. First, we can rule out the most extreme possibility, (a), that preschoolers lack the basic ability to map relations. One piece of counter-evidence, as discussed above, is that preschool children can abstract and map simple systems of spatial relations (Gentner, 1977a,b). A further demonstration is Crisafi and Brown's (1983) finding that in learning-transfer studies, three-year-old children can map

relational structures corresponding to problem representations across dissimilar physical situations. Finally, there is the evidence of preschoolers' spontaneous metaphors. Although, as Winner (1979) notes, many early metaphors are based primarily on perceptual-attribute overlap--as in the examples quoted earlier of comparing the moon to a hang nail or a banana--still, slightly older children produce metaphors that are clearly relational. The child I observed, Tad, at 3;2 had a favorite blanket he normally carried. On receiving a new blanket, he showed it to me saying "It's full of gas." He then pointed to the bedraggled old blanket and said "This one not . . . is . . . is out of gas." Such usages are evidence that young children are able to map relations.

Having ruled out explanation (a), lack of basic cognitive ability to map relations, we now have the remaining possibilities to consider: (b) inability to carry out complex mappings, (c) lack of pragmatic knowledge about the implicit rules for analogy, and (d) lack of domain knowledge. This study produced no direct evidence for or against possibility (b): that there is a developmental increase in the complexity of mappings that can be handled. However, Sternberg and Downing (1982) have evidence that adolescents go through some of the same stages of interpretation when dealing with complex analogies between analogies that younger children do with simple analogies. Whether this results from a change in cognitive processing

capacity or merely from learning mapping skills is unclear (Gentner & Brown, in preparation). In any case, it is possible that becoming able to manage more complex mappings is a factor in the development of metaphor.

We have some evidence for possibility (c), a change in knowledge of the pragmatics or aesthetics of the mapping conventions. Children's aptness ratings did not depend on the relationality of their interpretations in the way that adults' did. For adults, the criterion for aptness in metaphor appears to be maximal carryover of relations with minimal carryover of attributes; in contrast, we theorize that the aptness criterion for literal similarity is simply maximal carryover of predicates of all types (Gentner, 1983; Tversky, 1977). Children do not appear to share adult aesthetic standards for metaphor. It is possible that they simply fail to distinguish analogy/metaphor from literal similarity. This evidence must be regarded as tentative, since children may not have understood the aptness scale; still, changes in pragmatic knowledge remain a possible factor in development of metaphor.

Finally, we have evidence for possibility (d), that metaphoric development is partly reducible to an increase in domain knowledge. The age increase in number of proposition types suggests that the older subjects were bringing more different knowledge to bear on their interpretations. We suggest that adults performed more relationally than children in part

because they knew more about the domains. Knowing the knowledge structures in the individual domains gave adults more options for creating relational mappings.

The analysis of relational versus attributional information allows a more detailed view of how metaphoric strategies develop. The results presented here show, first, that a major trend in the development of metaphor is an increase in relational focus. Second, these results suggest that acquisition of knowledge plays a large role in the developmental increase in relationality. Carey (in press) has argued that developmental progressions can often be accounted for in terms of the acquisition of different kinds of knowledge. Here, we suggest that acquisition of both local domain knowledge and knowledge of the rules of mapping contribute to the developmental sequence. Third, our results support the structure-mapping approach, replicating and extending prior studies of relationality in metaphor interpretation.

The developmental picture that emerges is that the ability to map similar relational systems between different domains is present early in language development. However, more is required before this skill can be used appropriately by adult standards. Children must learn the conversational rules governing when figurative speech is appropriate and how it is signalled. They must learn the rules for aesthetic use of mappings. They must learn conceptual systems more abstract than the physical relations considered in this study before they can accurately

analogize about them. Finally, to deal with complex metaphors, a child may need to learn to map simultaneously many different relationships.

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Footnote

[1]This amplification technique was essentially one of restating metaphors as similes if a child did not understand. This was based on Reynolds and Orrony's (1980) finding that young children perform better with similes ("X is like a Y.") than with metaphors ("X is a Y.").

Table 1

Materials Used

RELATIONAL METAPHORS

The moon is like a lightbulb.
A camera is like a tape-recorder.
A ladder is like a hill.
A cloud is like a sponge.
A roof is like a hat.
Treebark is like skin.
A tire is like a shoe.
A window is like an eye.

ATTRIBUTIVE METAPHORS

Jellybeans are like balloons.
A cloud is like a marshmallow.
A football is like an egg.
The sun is like an orange.
A snake is like a hose.
Soap suds are like whipped cream.
Pancakes are like nickels.
A tiger is like a zebra.

DOUBLE METAPHORS

A doctor is like a repairman.
A kite is like a bird.
The sky is like the ocean.
A hummingbird is like a helicopter.
Plant stems are like drinking straws.
A lake is like a mirror.
Grass is like hair.
Stars are like diamonds.

Table 2

Sample Interpretations of Different Classes of Metaphors

AGE:	ATTRIBUTIONAL METAPHOR The sun is an orange.	RELATIONAL METAPHOR A tire is a shoe.	DOUBLE METAPHOR Plant stems are drinking straws.
5-6	"They're both orange." (1,5) "They're round and orange." (1,5)	"You can walk in shoes the same way you can go somewhere on tires." (5,1) "Sometimes your shoe is black and the tire is black." (1,5)	"They're both straight." (1,5) "They're both round." (1,5)
9-10	"They both are orange." (1,5) "It's like a circle and so is the sun." (1,5)	"A tire is on the bottom of a car and that's sort of like where your shoe would go if that was the body." (5,1) "You can go places on both." (5,1)	"Plant stems are thin and so are straws." (1,5) "If you put water down in the ground, the plant stems will soak up water just like the straws." (5,1)
Adult	"Both are orange; both spherical." (1,5) "The sun looks like an orange." (1,3)	"Both are coverings that come in direct contact with the terrain." (5,1) "Both are used for transportation of people or things; for protection also." (5,1)	"They are both used for drawing in water. They are both tubular." (5,5) "Both are straight and have liquid running through." (5,5)

Note: The figures in parentheses give the rated relationality and attributionality of the response.

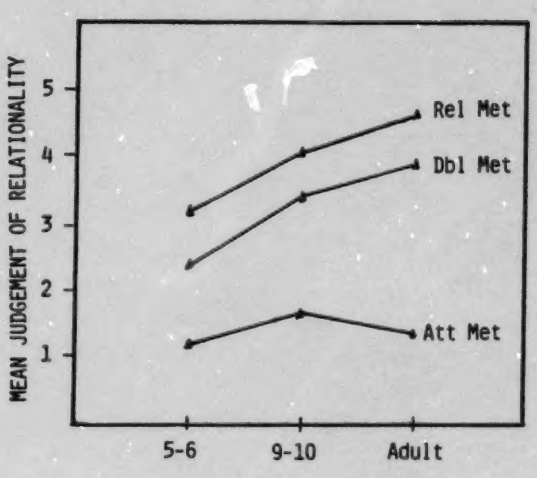
Figure Captions

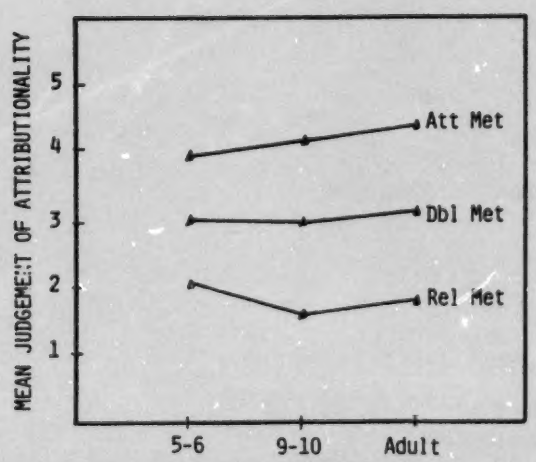
Figure 1a. Mean ratings of relationality for interpretations of different types of metaphor across age.

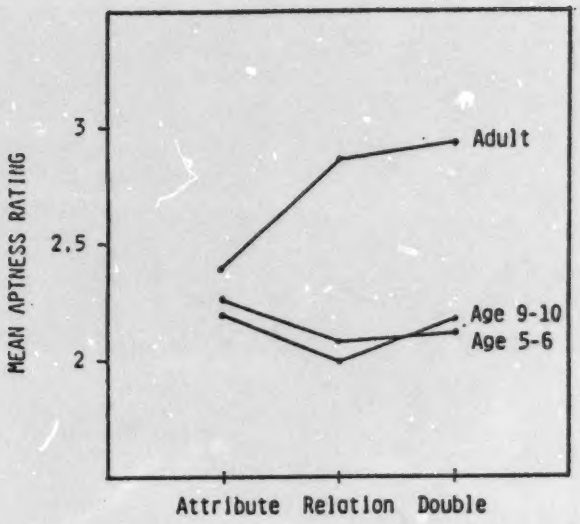
Figure 1b. Mean ratings of attributionality for interpretations of different types of metaphors across age.

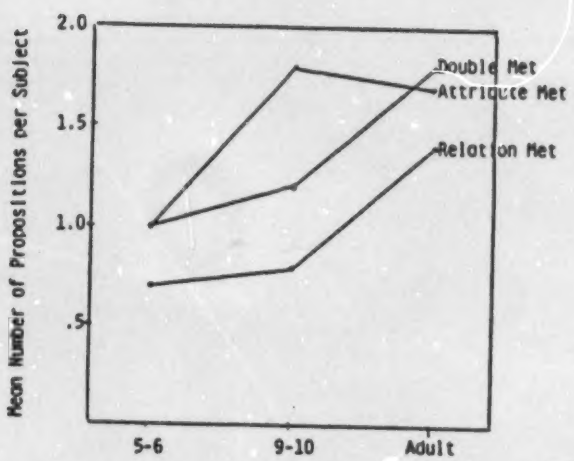
Figure 2. Mean aptness ratings for different types of metaphors across age.

Figure 3. Mean number of proposition types for different metaphor classes across age.


MEAN JUDGEMENT OF RELATIONALITY
5
4
3
2
1
Rel Met
Dbl Met
Att Met
5-6
9-10
Adult


MEAN JUDGEMENT OF ATTRIBUTIONALITY
5
4
3
2
1
Att Met
Dbl Met
Rel Met
5-6
9-10
Adult


MEAN APTNESS RATING
3
2.5
2
Adult
Age 9-10
Age 5-6
Attribute
Relation
Double


2.0
1.5
1.0
.5
Mean Number of Propositions per Subject
Double Met
Attribute Met
Relation Met
5-6
9-10
Adult